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REMARKS

Currently pending are independent claim 12 and dependent claims 13-24. Claim 12 recites a method for manufacturing a carbonaceous complex structure comprising: a step of forming a carbonaceous thin film on a smooth surface of a substrate and a step of forming a fullerene thin film on said thus formed carbonaceous thin film. Attached is a Version with Marking Showing Changes Made.

The examiner has suggested that the Abstract of the Disclosure be amended to reflect that the application is now directed to a method for forming a carbonaceous complex structure. Following is a new Abstract that describes a method for preparing a carbonaceous complex structure.

The examiner pointed out that on page 52, at line 18, "form" should be --from--. As can be seen by the above amendment to the paragraph beginning on page 52, line 8, this change has been made.

The examiner rejected claims 12-24 under 35 U.S.C. § 112, second paragraph, as indefinite. As can be seen by the above amendments, the claims have been amended so as to overcome this ground for rejection. In particular, claim 12 has been amended to provide an antecedent basis for "said smooth film" in claim 14 and claims 15 and 17 have been amended to use the phrase "fullerene thin film," which phase finds support in claim 12.

Claim 17 has been amended to make clear that it covers a method that includes the additional step of layering a pair of pair of spaced apart electrodes on the carbonaceous thin film such that the fullerene thin film is formed at least in the space between said electrodes. Claim 18 has been deleted.

Claim 20 has been amended to make clear that it covers a method in which the fullerene thin film is polymerized by plasma polymerization, micro-wave polymerization, electrolytic polymerization, electron beam polymerization, X-ray polymerization or photopolymerization. Claim 21 has been rewritten to avoid having to provide an antecedent basis for the phrase "fullerene molecules."

Moreover, the examiner's suggestions have been adopted and the phrases "of fullerene molecules" and "in vapor-deposition said fullerene . . . electromagnetic waves" have been deleted. Finally, claim 22 has been rewritten to avoid having to provide an antecedent basis for the phrase "said vacuum chamber". Therefore, all the pending claims recite the patentable

subject matter with a reasonable degree of particularity and distinctness, so that the rejection of the claims under 35 U.S.C. § 112, second paragraph has been overcome.

The examiner rejected claims 12-24 under 35 U.S.C. § 103(a) as obvious in light of a combination of Bethune *et al.* and Bhushan *et al.* The examiner argues that:

> Buthune discloses a method of depositing an amorphous carbon film followed by a fullerene layer (col. 11, line 41 - col. 12, line 23). The amorphous carbon can be deposited by high energy beams including ion beams (col. 6, lines 51-65).

Apparently, however, instead of relying on the disclosure of Buthune, the examiner actually is relying on the disclosure of another patent, Tanaka (6,017,630). Applicants respectfully submit that the examiner misunderstands the teachings of Tanaka. As discussed at col. 11, line 41 - col. 12, line 23 and shown in Figs 4A and 4B, Tanaka discloses a method where the substrate *is* the amorphous carbon film. It does not disclose nor would it have suggested a method where an intermediate carbon film is used to adhere a fullerene film to a distinct substrate. As explained at col. 11, lines 44-47, "A process for producing the giant fullerene shown in FIG. **4** is the same as the process for producing ultrafine particles shown in FIG. **1** excepting that an amorphous carbon *substrate* is used as the *substrate*." (Emphasis added.) An adherent carbonaceous thin film is not deposited on a smooth surface of a substrate, for example by high energy beams including ion beams as suggested by the examiner. Instead, "an amorphous carbon film **21** is placed on a supporting member **2**." (Col. 11, lines 48 and 49.) Far from being a substrate having a smooth surface, as is seen in the examples, the supporting member is a metallic mesh.

Furthermore, column 6, lines 51-65, the section of Tanaka relied upon by the examiner, does not describe the use of a high energy beam to deposit a carbonaceous film on a substrate. Instead, this section describes using a high energy beam to "to detach the constituent atoms or molecules from the target material **3**" placed on the amorphous carbon substrate **21**." Suitable target materials are discussed at column 6, lines 12-16 and include, "Pt, Au, Cu and Al used alone and alloys thereof; semiconductors such as Si; compounds such as metal oxides, metal chlorides, metal fluorides and metal borides." Consequently, Tanaka does not disclose or suggest a method in which an adherent carbonaceous thin film is formed on a smooth surface of

a substrate and then an adherent fullerene thin film is formed on said thus formed carbonaceous thin film.

Bhushan is cited merely because it allegedly discloses "a method for coating fullerene materials by decomposing organic materials." However, nothing in Bhushan whether considered alone or considered in combination with Tanaka would have suggested a method in which an adherent carbonaceous thin film is formed on a smooth surface of a substrate and then an adherent fullerene thin film on said thus formed carbonaceous thin film. Therefore, the rejection of claims 12-24 under 35 U.S.C. § 103(a) should be withdrawn.

CONCLUSION

In light of the foregoing amendments and remarks, it is believed that the application is in condition for allowance and, therefore, a prompt and favorable response is respectfully submitted.

Respectfully submitted,

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June 3, 2002

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Version with Marking Showing Changes Made

In the Specification:

The Abstract of the Disclosure has been replaced with the following abstract:

A method for preparing acarbonaceous complex structure including forming an adherent carbonaceous thin film on a smooth surface of a substrate and forming a fullerene thin film on the thus formed carbonaceous thin film [in which a fullerene thin film is used as a part of the constituent material to improve adhesion between neighboring layers to enable a solar cell or a sensor to be produced to high strength, and a method for manufacturing the carbonaceous complex structure, are disclosed. The carbonaceous complex structure includes a substrate 1 of quartz or glass, on which are layered a carbonaceous thin film 2 and a fullerene thin film 3. Thermal decomposition of an organic compound is used for forming the carbonaceous thin film 2, whilst a method for vapor-depositing or polymerizing fullerene is used for forming the fullerene thin film 3].

In the Specification

The paragraph beginning at page 52, line 8 has been amended as follows:

For clarifying the structure of the carbonaceous thin film formed on the ground silicon substrate, mass spectroscopic analysis was carried out in accordance with the Laser-Desorption-Ionization Time-of-Flight method. For measurement, a Thermoquest Vision 2000 TOF-MS monitor was used. The laser used for ablation was a nitrogen laser. Before measurement, a silicon substrate was cut to a size of 5 mm and set on a target of the TOF-MS monitor. For measurement, a pulse laser was directly illuminated on the surface of the carbonaceous thin film for excitation, desorption and ionization. Positive ions were used for measurement. Figs.43 to 45 show the spectrum with increased laser strength. However, the laser power in Fig.44 is not so strong as to vary the election valence state of carbon. As may be seen [form] from Fig.44, a cluster up to 20 carbon atoms is ascribable to a continuous peak of the difference corresponding to a carbon atom and mainly to a component in the valency state of

sp3. In Fig.45, a cluster up to approximately 30 carbon atoms is mainly ascribable to a component in the valency state of sp3. If the laser power is increased further, a continuous peak with a difference of C2 from 50 to approximately 150 carbon atoms is observed. This is the peak proper to the carbon having the graphitic structure of sp2. It is seen from these that the carbonaceous thin film has a structure of an extremely small graphite in the random sp3 carbon.

In the Claims

Claims 12-24 have been amended as follows:

12. (amended) A method for manufacturing a carbonaceous complex structure comprising:

a step of forming a carbonaceous thin film on a smooth surface of a substrate [by thermal decomposition of an organic compound] and

a step of forming a fullerene thin film on said thus formed carbonaceous thin film.

15. (amended) The method for manufacturing a carbonaceous complex structure according to claim 14 wherein

a first electrode, said carbonaceous thin film, said fullerene [polymer] thin film and a second electrode are layered in this order on said substrate.

17. (amended) The method for manufacturing a carbonaceous complex structure according to claim 12 [wherein] further comprising the step of

layering [said carbonaceous thin film and] a pair of spaced apart electrodes [are layered in this order] on said [substrate and wherein] carbonaceous thin film such that said fullerene [polymer] thin film is formed at least in the space between said electrodes.

20. (amended) The method for manufacturing a carbonaceous complex structure according to claim 19 wherein

the fullerene polymerization method is a plasma polymerization method, a micro-wave polymerization method, an electrolytic polymerization method, an electron beam polymerization method, an X-ray polymerization method or a photopolymerization method.

21. (amended) The method for manufacturing a carbonaceous complex structure according to claim 12 wherein

said fullerene thin film is formed by [molecules are] vapor deposit[ed] ion of fullerene molecules to form a vapor-deposited film and then [which then is] illuminat[ed]ing said film of fullerene molecules by electromagnetic waves to polymerize said fullerene molecules [to produce a fullerene polymer film which is used as a constituent layer of the carbonaceous complex structure].

22. (amended) The method for manufacturing a carbonaceous complex structure according to claim 21 wherein

the film thickness of [a] said vapor-deposited film [of said fullerene molecules] is measured and controlled [in vapor-depositing said fullerene molecules to form a vapor-deposited film of a pre-set thickness which then is polymerized by illumination of said electromagnetic waves].

23. (amended) The method for manufacturing a carbonaceous complex structure according to claim 22 wherein

said film thickness is measured by a film thickness meter arranged in [said] a vacuum chamber.